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POLYACETAL RESIN COMPOSITION
[Poriasetaaru jushi soseibutsu]

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(54) [Title of the Invention]

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Polyacetal Resin Composition

[Claim(s)]

[Claim 1] A polyacetal resin composition comprised by compounding, per 100 parts by weight of a (A) thermoplastic polyacetal resin,

(B) 1 to 100 parts by weight of an acid anhydride-denatured polyolefin-based resin,

(C) 0.01 to 5 parts by weight of an esterification reaction catalyst, and

(D) 0 to 150 parts by weight of one or more fillers selected from among a fibrous filler, granular filler, platy filler and hollow-shaped filler.

[Claim 2] The polyacetal resin composition of Claim 1, wherein 100 parts by weight of a polyolefin-based resin are denatured with 0.1 to 30 parts by weight of an acid anhydride for the (B) acid anhydride-denatured polyolefin-based resin.

[Claim 3] The polyacetal resin composition of Claim 1 or 2, wherein the esterification reaction catalyst (C) is one or more compounds selected from a group comprising a pyridine or its derivatives, or its salt and a tertiary amine or a derivative thereof.

[Claim 4] The polyacetal resin composition of Claim 1 or 2, wherein the esterification reaction catalyst (C) is one or more

*Claim and paragraph numbers correspond to those in the foreign text.

compounds selected from a group comprising a quaternary ammonium salt or its derivatives, an aliphatic organic acid or aromatic organic acid, or their salts, an organometallic compound, zinc chloride, magnesium titanate and magnesium zirconate.

[Claim 5] The polyacetal resin composition of any one of Claims 1 to 4, wherein the content of the hydroxyl groups in the resin of the polyacetal resin (A) is 30 mmol/kg.

[Detailed Specifications]

[0001] [Field of Industrial Application]

The present invention relates to a resin composition in which the affinity between a thermoplastic polyacetal resin and a resin of a polymer blend comprising a polyolefin-based resin was improved, and an improvement in the impact resistance was realized without compromising the mechanical and thermal characteristics of the polyacetal resin.

[0002] [Prior Art and Problems to be Solved by the Invention]

Polyacetal resins have excellent characteristics, i.e., mechanical and thermal characteristics, slidability, moldability, molded product dimensional stability, and the like, and are used widely in electrical equipment, automobile parts, precision machine parts, and the like as structural materials, mechanical parts, etc. However, when they were used in applications requiring any kind of high impact resistance, such as housings for, e.g., consumer products, they had drawbacks, because the surface impact strength was

insufficient, among other drawbacks. In order to improve such drawbacks, methods, among other methods, have been attempted in the past in which, e.g., rubbery constituents, such as polyurethane and olefin-based elastomers, were blended. However, there are problems, among other problems, because poor dispersion arises when the polyacetal resin is simply melted and mixed in order to improve the affinity between the elastomer constituent and the polyacetal resin added, and moreover, the excellent characteristics of the polyacetal resin are compromised because the interfacial bond strength between each resin is insufficient, surface peeling of a molded product arises, and a sufficient impact resistance is not obtained. In order to overcome these problems, improvements, among other improvements, were performed by compounding a copolymer in which a polar comonomer constituent, such as methyl methacrylate, was introduced into, e.g., a polyolefin resin, and a resin containing a reactive glycidyl group in the polymer structure was compounded with the polyacetal resin. However, this has not led to an improvement in the impact resistant of a polyacetal being put to practical use sufficiently.

[0003] [Means for Solving the Problems]

Therefore, as a result of intensely investigating such key points, the inventors of the present invention succeeded in obtaining a molded resin material to which impact resistance was added without compromising the excellent mechanical and thermal characteristics of the polyacetal resin wherein the affinity between the polyacetal

resin and the polyolefin-based resin was improved, by compounding a polyolefin-based resin having an acid anhydride group with sufficient reactivity with a thermoplastic polyacetal resin, and a catalyst for accelerating these reactions, which led them to completing the present invention. That is, the present invention is a polyacetal resin composition comprised by compounding, per 100 parts by weight of a (A) thermoplastic polyacetal resin, (B) 1 to 100 parts by weight of an acid anhydride-denatured polyolefin-based resin, (C) 0.01 to 5 parts by weight of an esterification reaction catalyst, and (D) 0 to 150 parts by weight of one or more fillers selected from among a fibrous filler, granular filler, platy filler and hollow-shaped filler.

[0004] The constituent components of the present invention will now be described. The "polyacetal resin" in the present invention is a thermoplastic resin composed mainly of a polymer compound using an oxymethylene unit ($-\text{CH}_2\text{O}-$) as the main repeating constituent unit. One in which a formaldehyde or trioxane, tetraoxane, or the like was subjected to a homopolymerization in the usual method, or a copolymer of a cyclic ether, such as ethylene oxide, propylene oxide, oxacyclobutane, or 1,3-dioxolane; a cyclic ester, such as β -propiolactone or γ -butyrolactone; certain kinds of vinyl compounds, and the like are used as the constituent (A). In addition, a portion of the end of the molecule of this polyacetal resin may be converted to an ether bond, ester bond, etc. Furthermore, it is more preferable

if some or all of this polyacetal resin be a polyacetal resin having a high, e.g., hydroxyl group content manufactured in a method, as shown below (hereinafter called "enriched hydroxyl group polyacetal resin"), and in such a case, the advantages of the present invention are more remarkable. In addition, in this case, if the hydroxyl group content of the polyacetal resin is 30 mmol/kg or greater, especially preferable results are obtained. There are methods, among other methods, in which a small amount of a compound containing the hydroxyl group(s) of water, ethylene glycol, glycerin, glycidol, or the like is added while performing polymerization on, e.g., trioxane with a cationic initiator, such as BF_3 , but the method of manufacture thereof is not particularly limited thereto. In addition, the polymerization degree thereof, the presence of branched chains, whether it is a homopolymer or a copolymer, or the type of copolymerization, such as a random, block or graft copolymerization, does not matter. The bonding site of the hydroxyl group is not limited in particular either.

[0005] The constituent (B) of the present invention is an acid anhydride-denatured polyolefin-based resin in which a polyolefin-based resin was denatured with an acid anhydride. Random, block or graft copolymers and the like comprised by containing one or more comonomer constituents of a homopolymer of an α -olefin, such as ethylene, propylene, butane, hexane, octane, nonene, decene or dodecene; a random, block or graft copolymer comprising two or more

of these homopolymers; an unconjugated diene, such as 1,4-hexadiene, dicyclopentadiene, 5-ethylidene-2-norbornene, 2,5-norbornadiene; an α,β -unsaturated acid, such as an acrylic acid or methacrylic acid, or an ester and the like derivatives thereof; an aromatic vinyl compound, such as acrylonitrile, styrene, or α -methyl styrene; a vinyl ester, such as vinyl acetate; a vinyl ether, such as vinyl methyl ether; derivatives of these vinyl-based compounds; and the like are cited for the polyolefin-based resin used here. Any kind of polymerization degree thereof, presence and extent of side chains or molecular chains, copolymer composition ratio, and the like is applicable. And one or more compounds selected from among unsaturated carboxylic acid anhydrides, such as maleic anhydride, citraconic anhydride, itaconic anhydride, tetrahydrophthalic anhydride, nadic anhydride, methyl nadic anhydride, and allyl succinic anhydride, or their derivatives, and so forth may be used for the acid anhydride used for denaturation. In addition, for the denaturing method thereof, a method in which an unsaturated carboxylic acid anhydride, such as polyolefin-based resin or maleic anhydride, or a derivative thereof is heated and reacted with a radical initiator, such as a suitable organic peroxide, in a solution state or molten state, among other methods, is ideal. Here, the amount of each constituent added is suitably 0.1 to 30 parts by weight of the acid anhydride per 100 parts by weight of the polyolefin-based resin. When the amount of the available acid anhydride in the acid anhydride-denatured polyolefin-based resin is

too low, the affinity between the polyacetal resin and the polyolefin-based resin is not improved enough; hence, the advantages of the present invention are not obtained. And when it is too high, gelling arises, and may cause poor dispersibility and defective molding. The amount of the constituent (B) compounded is 1 to 100 parts by weight, and preferably, 5 to 50 parts by weight per 100 parts by weight of the constituent (A). If the amount of the constituent (B) compounded is too low, the advantages of the present invention are not manifested enough, and if there is too much of it, the characteristics of the polyacetal resin are compromised.

[0006] Various metallic compounds, i.e., pyridine derivatives or their salts, such as pyridine, 4-dimethyl aminopyridine, and 4-pyrrolizinopyridine salts; tertiary amines and their derivatives, such as triethyl amine, trimethyl amine, triethylene diamine, N,N'-dimethyl piperidine, benzylmethyl amine and dimethyl aniline; quaternary ammonium salts and their derivatives, such as trimethylbenzyl ammonium chloride; aliphatic organic acids and aromatic organic acids, such as acetic acid and benzoic acid; salts of organic acids, such as sodium acetate, sodium laurate, and sodium para-toluene sulfonate; organometallic compounds, such as tetrabutyl zirconate, zirconium naphthate, tetrabutyl titanate, tetraoctyl titanate, tetraphenyl tin, zinc acetate, stannous oxalate, zinc naphthenate, iron acetyl acetate, manganese naphthenate, triphenyl antimony, tributyl antimony, triphenyl bismuth, and dibutyl tin

dichloride; zinc chloride; magnesium titanate; magnesium zirconate; and the like are cited for the catalyst, which is constituent (C), for accelerating the esterification reaction used in the present invention. One or more compounds thereof may be added. A pyridine or its derivatives, or salts thereof, and a tertiary amine or its derivatives are cited for especially preferred catalysts from the standpoint of heat stability, hue, etc. The amount of the constituent (C) compounded is suitably 0.01 to 5 parts by weight per 100 parts by weight of the constituent (A). When the amount of the catalyst is too low, the reaction does not proceed sufficiently, while the advantages of the present invention may not be obtained.

[0007] The filler, i.e., the constituent (D) used in the present invention is not always a mandatory constituent, but it is preferable to compound it to obtain a molded product having excellent performance, such as mechanical strength, heat resistance, dimensional stability, and electrical properties. A fibrous, granular, platy or hollow-shaped filler is employed, depending on the purpose, for the constituent (D). Inorganic fibrous substances, such as glass fibers, asbestos fibers, carbon fibers, silicon fibers, silica alumina fibers, zirconia fibers, boron nitride fibers, silicon nitride fibers, boron fibers, potassium titanate fibers, and further, metal fibrous substances, such as stainless steel, aluminum, titanium, copper, and brass ones, are cited for the fibrous filler. In particular, glass fibers or carbon fibers are often used. Moreover,

high-melting point organic fibrous substances, such as aromatic polyamide resins, fluororesins, and acryl resins, also can be used. Silicic acid salts, such as carbon black, silica, quartz powder, glass beads, glass powder, calcium silicate, aluminum silicate, kaolin, talc, clay, diatomaceous earth, and Wollastonite; metal oxides, such as iron oxide, titanium oxide, and alumina; metallic sulfuric acid salts, such as calcium sulfate and barium sulfate; carbonic acid salts, such as calcium carbonate, magnesium carbonate, and dolomite; and silicon carbide; silicon nitride; boron nitride; various metal powders; and the like are cited for the granular filler. Mica, glass flakes, various metal foils, and the like are cited for the platy filler, while shirasu balloons, metal balloons, glass balloons, and the like are cited for the hollow-shaped filler. Fillers whose surface was treated with organosilane, organoborane, organotitanate, urethane, and the like can be used preferably for these fillers. It is possible to use these fillers singly or by combining two or more of them. The joint use of a fibrous filler, and in particular, glass fibers and carbon fibers, and a granular or platy filler is the preferred combination for having both mechanical strength and dimensional accuracy, electrical properties, or the like. The amount of the constituent (D) compounded is at least 150 parts by weight per 100 parts by weight of the constituent (A). It is not preferable if the amount added is excessive because the molding workability and tenacity may be compromised.

[0008] The composition of the present invention is prepared [Translator's note: misspelled in source as 'adjusted'] by melting and mixing the aforementioned respective constituents in various methods. For example, a method in which the acetal resin(s), acid anhydride-denatured polyolefin-based resin(s), and catalyst(s) are melted and kneaded at the prescribed amounts, cooled, and subsequently cut into the shape of pellets is cited as an example, but the compounding time and method thereof for each constituent is not limited in particular. Moreover, at this time, if necessary, any given amount of antioxidant, UV absorber, photoprotective agent, phosphite stabilizer, peroxide decomposing agent, basic adjuvant, nucleating agent, plasticizer, lubricant, antistatic agent, flame retardant, colorant, and the like may be compounded in a range which does not compromise the physical properties in the present invention. Furthermore, it is possible to suitably compound other polymers with the composition of the present invention as long as they fall within ranges that do not compromise the physical properties thereof. Moreover, the composition obtained according to the present invention may be molded in the usual method.

[0009] [Advantages of the Invention]

The composition obtained according to the present invention is such that, by improving the affinity between the polyacetal resin and the polyolefin-based resin, the excellent properties of the polyacetal resin, i.e., thermal properties and mechanical strength

continue to be maintained, the impact resistance is remarkably improved, there is no defective appearance or surface peeling of the molded product based on defective dispersion of the dispersion resin, and its use in many applications can be anticipated.

[0010] [Practical Examples]

The present invention will now be described more specifically through the practical examples, but the present invention is not limited to them.

[Practical Example 1]

5 parts by weight of a maleic anhydride-denatured polypropylene I (B) wherein 100 parts by weight of the polyacetal resin (A) and 100 parts by weight of a polypropylene resin (Hypol J440, made by Mitsui Petrochemical Industries, Co. Ltd.) were denatured with 10 parts by weight of maleic anhydride, and 0.2 parts by weight dimethyl aminopyridine were mixed as the constituent (C) catalyst, then melted and kneaded in a 30 mm biaxial extruder at a set temperature of 190°C and a screw rotational frequency of 80 rpm, and pelletized. Next, these pellets were molded into test pieces with an extrusion molding machine, and evaluations of the below-mentioned Izod impact strength and surface peel test were performed. The evaluation results are shown in Table 1.

(Izod impact strength)

The notched impact strength (kgf-cm/cm) was measured in accordance with ASTM D256.

(Surface peel test)

This was evaluated by sticking cellophane tape to the surface of the test piece, tearing it off, and subsequently observing the peeled state. A test piece where no peeling was observed was evaluated as ○ and one in which it was observed was evaluated as ×.

[Practical Examples 2 to 4]

As shown in Table 1, except for changing the amount of the (B) maleic anhydride-denatured polypropylene I thus compounded, a test piece was manufactured as in Practical Example 1, and evaluated in the same manner. The formulations and evaluation results are shown in Table 1.

[Comparative Example 1]

Only the polyacetal resin was blended, but the test piece was manufactured as in Practical Example 1, and evaluated in the same manner. The formulations and evaluation results are shown in Table 1.

[Comparative Examples 2 to 4]

Except for changing the amounts of the constituent (B) and constituent (C) thus compounded, the test piece was manufactured as in Practical Example 1, and evaluated in the same manner. The formulations and evaluation results are shown in Table 1.

[0011] [Practical Example 5]

Except for compounding 20 parts by weight of a maleic anhydride-denatured polypropylene II wherein the maleic anhydride denaturation rate was set to 5 parts by weight per 100 parts by weight of polypropylene in place of the maleic anhydride-denatured polypropylene I (B), a test piece was manufactured as in Practical Example 2, and evaluated in the same manner. The formulations and evaluation results are shown in Table 2.

[Practical Example 6]

Except for compounding 20 parts by weight of a maleic anhydride-denatured polypropylene III wherein the maleic anhydride denaturing rate was set to 25 parts by weight per 100 parts by weight of polypropylene in place of the maleic anhydride-denatured polypropylene II (B), a test piece was manufactured as in Practical Example 5, and evaluated in the same manner. The formulations and evaluation results are shown in Table 2.

[Comparative Example 5]

Except for compounding 20 parts by weight of a maleic anhydride-denatured polypropylene denatured with 10 parts by weight maleic acid per 100 parts by weight of polypropylene in place of the maleic anhydride-denatured polypropylene III (B), a test piece was manufactured as in Practical Example 6, and evaluated in the same manner. The formulations and evaluation results are shown in Table 2.

[Comparative Example 6]

Except for compounding 20 parts by weight of an undenatured polypropylene resin in place of the maleic anhydride-denatured polypropylene III (B), a test piece was manufactured as in Practical Example 6, and evaluated in the same manner. The formulations and evaluation results are shown in Table 2.

[0012] [Practical Examples 7 and 8]

Except for changing the amount of the dimethylamino pyridine constituent C, test pieces were manufactured as in Practical Example 2, and evaluated in the same manner. The formulations and evaluation results are shown in Table 3.

[Practical Examples 9 to 13]

Except for using triethylene diamine, trimethylbenzyl ammonium chloride, sodium acetate, tetrabutyl zirconate and zinc chloride as the constituent (C), test pieces were manufactured as in Practical Example 2, and evaluated in the same manner. The formulations and evaluation results are shown in Table 3.

[0013] [Practical Example 14]

Except for compounding 20 parts by weight of a maleic anhydride-denatured ethylene-propylene copolymer (EPR) denatured with 10 parts by weight of maleic anhydride per 100 parts by weight of the EPR in place of the maleic anhydride-denatured polypropylene I (B), a test piece was manufactured as in Practical Example 2, and evaluated in

the same manner. The formulations and evaluation results are shown in Table 4.

[Comparative Example 7]

Except for using an undenatured EPR in place of the maleic anhydride-denatured EPR (B), a test piece was manufactured as in Practical Example 14, and evaluated in the same manner. The formulations and evaluation results are shown in Table 4.

[0014] [Practical Examples 15 to 17, Comparative Examples 8 to 11]

Except for further compounding glass fibers as the constituent (D), test pieces were manufactured as in the aforesaid practical examples, and evaluated in the same manner. The formulations and evaluation results are shown in Table 5.

[0015] [Practical Examples 18 and 19, Comparative Examples 12 to 14]

Except for using a hydroxyl group-rich polyacetal resin having a 100 mmol/kg hydroxyl group content as the constituent (A), test pieces were manufactured as in the aforesaid practical examples, and evaluated in the same manner. The formulations and evaluation results are shown in Table 6.

[Practical Examples 20 and 21]

When glass fibers were further compounded as the constituent (D), test pieces were manufactured as in the aforesaid Practical Examples 18 and 19, and evaluated in the same manner. The formulations and evaluation results are shown in Table 6.

[Comparative Examples 15 to 18]

When glass fibers were further compounded as the constituent (D), test pieces were manufactured as in the Comparative Examples 12 to 14, and evaluated in the same manner. The formulations and evaluation results are shown in Table 6.

[0016] [Practical Examples 22 to 25]

When a filler was compounded in place of the glass fibers as the constituent (D), and when glass fibers and mica were combined therewith, test pieces were manufactured as in the aforesaid practical examples, and evaluated in the same manner. The formulations and evaluation results are shown in Table 7.

Comparative Examples 19 to 22

Except for using an undenatured polypropylene in place of the maleic anhydride-denatured polypropylene I (B), test pieces were manufactured, as in the aforesaid Practical Examples 22 to 25, and evaluated in the same manner. The formulations and evaluation results are shown in Table 7.

[0017] [Table 1]

	Unit	Prac-tical Example 1	Prac-tical Example 2	Prac-tical Example 3	Prac-tical Example 4	Compara- tive Example 1	Compara- tive Example 2	Compara- tive Example 3	Compara- tive Example 4
(A) Polyacetal Resin	Parts by weight	100	100	100	100	100	100	100	100
(B) Maleic anhydride-denatured polypropylene I	Parts by weight	5	20	40	80			120	20
(C) Dimethyl amino pyridine	Parts by weight	0.2	0.2	0.2	0.2		0.2	0.4	
Izod Impact Strength	kgf-cm/cm	11.5	12.1	14.8	18.2	6.5	6.4	13.1	5.7
Surface Peel Test	-	±	±	±	±	±	±	H	H

[0018] [Table 2]

	Unit	Practical Example 5	Practical Example 6	Comparative Example5	Comparative Example 6
(A) Polyacetal Resin	Parts by weight	100	100	100	100
(B) Maleic anhydride-denatured polypropylene II	Parts by weight	20			
(B) Maleic anhydride-denatured polypropylene III	Parts by weight		20		
(B') Maleic anhydride-denatured polypropylene	Parts by weight			20	
(B') Undenatured polypropylene	Parts by weight				20
(C) Dimethyl amino pyridine	Parts by weight	0.2	0.2	0.2	0.2
Izod Impact Strength	kgf-cm/cm	11.6	13.6	5.8	3.5
Surface Peel Test	-	±	±	H	H

[0019] [Table 3]

	Unit	Prac- tical Example 7	Prac- tical Example 8	Practical Example 9	Practical Example 10	Practical Example 11	Practical Example 12	Practical Example 13
(A) Polyacetal Resin	Parts by weight	100	100	100	100	100	100	100
(B) Maleic anhydride-denatured polypropylene I	Parts by weight	20	20	20	20	20	20	20
(C) Dimethyl amino pyridine	Parts by weight	0.03	4					
(C) Triethylene diamine	Parts by weight			0.2				
(C) Trimethylbenzyl ammonium chloride	Parts by weight				0.2			
(C) Sodium acetate	Parts by weight					0.1		
(C) Tetrabutyl zirconate	Parts by weight						0.2	
(C) Zinc chloride	Parts by weight							0.2
Izod Impact Strength	kgf-cm/cm	11.7	13.3	12.0	10.3	9.8	10.7	10.1
Surface Peel Test	-	±	±	±	±	±	±	±

[0020] [Table 4]

	Unit	Practical Example 4	Comparative Example 7
(A) Polyacetal Resin	Parts by weight	100	100
(B) Maleic anhydride-denatured EPR	Parts by weight	20	
(B') Udenatured EPR	Parts by weight		20
(C) Dimethyl amino pyridine	Parts by weight	0.2	0.2
Izod Impact Strength	kgf-cm/cm	18.9	5.7
Surface Peel Test	-	±	H

[0021] [Table 5]

	Unit	Practical Example 15	Practical Example 16	Practical Example 17	Compara- para- tive Example 8	Compara- tive Example 9	Compara- tive Example 10	Compara- tive Example 11
(A) Polyacetal Resin	Parts by weight	100	100	100	100	100	100	100
(B) Maleic anhydride-denatured polypropylene I	Parts by weight	20	30	50				
(B') Udenatured polypropylene	Parts by weight						20	50
(C) Dimethyl amino pyridine	Parts by weight	0.2	0.2	0.3				
(D) Glass fibers	Parts by weight	20	40	80	20	80	20	80
Izod Impact Strength	kgf-cm/cm	22.1	25.7	28.9	8.4	10.1	5.0	6.0
Surface Peel Test	-	±	±	±	±	H	H	H

[0022] [Table 6]

	Unit	Prac- tical Exam- ple 18	Prac- tical Exam- ple 19	Com- para- tive Exam- ple 12	Com- para- tive Exam- ple 13	Com- para- tive Exam- ple 14	Prac- tical Exam- ple 20	Prac- tical Exam- ple 21	Com- para- tive Exam- ple 15	Com- para- tive Example 16	Com- para- tive Example 17	Com- para- tive Example 18
(A) Hydroxyl group-rich polyacetal resin	Parts by weight	100	100	100	100	100	100	100	100	100	100	100
(B) Maleic anhydride- denatured polypropylene I	Parts by weight	20	50				20	50				
(B') Udenatured polypropylene	Parts by weight				20	50						
(C) Dimethyl amino pyridine	Parts by weight	0.2	0.3		0.2	0.3	0.2	0.3			0.2	0.3
(D) Glass fibers	Parts by weight						30	60	30	80	30	60
Izod Impact Strength	kgf-cm/cm	15.0	18.2	6.0	4.2	4.5	27.4	33.2	7.6	8.2	4.3	6.7
Surface Peel Test	-											

[0023] [Table 7]

	Unit	Prac- tical Example 22	Compara- tive Example 19	Prac- tical Example 23	Compara- tive Example 20	Prac- tical Example 24	Compara- tive Example 21	Prac- tical Example 25	Compara- tive Example 22
(A) Polyacetal resin	Parts by weight	100	100	100	100	100	100	100	100
(B) Maleic anhydride- denatured polypropylene I	Parts by weight	30		30		30		30	
(B') Undenatured polypropylene	Parts by weight		30		30		30		30
(C) Dimethyl amino pyridine	Parts by weight	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
(D) Glass fibers	Parts by weight							20	20
(D) Glass beads	Parts by weight	30	30						
(D) Mica	Parts by weight			30	30			10	10
(D) Glass balloons	Parts by weight					30	30		
Izod Impact Strength	kgf-cm/cm	9.8	2.0	9.5	1.6	9.5	1.9	16.6	4.6
Surface Peel Test	-	±	H	±	H	±	H	±	H